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I, the below-named translator, hereby declare:

(1) That my name, mailing address and citizenship are as stated below;

(2) That I am knowledgeable in the English language and in the Japanese language in which Japan Patent Application No. 2001-195827 was filed on June 28, 2001; and

(3) That I have translated said Japan Patent Application No. 2001-195827 into English, whose English text is attached hereto, and believe that said translation is a true and complete translation of the aforementioned Japan patent application.

July 15, 2005

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JAPAN PATENT OFFICE

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- Abstract 1

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[TITLE OF INVENTION]

FLUORESCENT RADIATION DEVICE

[CLAIMS]

1. A fluorescent radiation device comprising:

a linear member fixed under the condition that a tension force is applied thereto,

wherein a fixing portion or an attaching portion of the linear member includes a body member and a metallic additional member,

wherein the additional member is fixed by an ultrasonic bonding to a metal film formed on a base.

2. The fluorescent radiation device of claim 1, wherein the metal film formed on the base is formed in a thin film.

3. The fluorescent radiation device of claim 1 or 2, wherein the linear member is formed in a cladding of a metallic member of the body member and a metallic member of the additional member.

4. The fluorescent radiation device of claim 1 or 2, wherein the body member of the linear member is a wire grid having a metallic member and an insulating member.

5. The fluorescent radiation device of claim 1 or 2, wherein the linear member is a cathode filament where the additional member is formed at the fixing portion or the attaching portion.

6. The fluorescent radiation device of claim 1 or 2, wherein the linear member is a wire damper where the additional member is formed at least at the fixing portion or the attaching portion.

[DETAILED DESCRIPTION OF THE INVENTION]

[FIELD OF THE INVENTION]

The present invention relates to an attaching structure of a linear member, which is fixed under the condition that a tension force is applied thereto, such as a wire grid, a cathode filament, a wire damper or the like, in a fluorescent radiation device.

[DESCRIPTION OF THE PRIOR ART]

Fig. 6 shows a top view and a sectional view of an anode substrate, in which a cathode filament and a filament damper is installed, of a fluorescent display tube, which is a kind of conventional fluorescent radiation device. Fig. 6(a) is the top view, Fig. 6(b) is a perspective view of a filament anchor and

Fig. 6(c) is a perspective view of a damper supporting member. An end of a filament 61 is fixed to the metallic anchor 62, and the other end thereof is fixed to the support (not shown). The anchor 62 gives a predetermined tension to the filament 61. An attaching portion 621 of the anchor 62 is fixed to a retainer plate (not shown) formed in the anode substrate 60 which consists of insulating materials, such as glass and a ceramic. Reference number 65 designates an anode electrode having a fluorescent substance applied thereon. An end of the filament 61 is interposed between a supporting portion 622 of the anchor 62 and a metal piece 623, and then the metallic piece 623 is fixed to the supporting portion 622 by a welding. The welding is carried out by applying an electric current on a pair of heating electrodes disposed at bottom of the supporting portion 622 and top of the metallic piece 623.

A damper 63 has both ends fixed to the metallic supporting member 64 (only one end is displayed), and is laid between both the supporting member 64 under a predetermined tension. The end of the damper 63 is interposed between the attaching portion 642 of the supporting member 64 and the metallic piece 643, and is welded to the supporting portion 642 and the metallic piece 643. The supporting member 64 is installed by fixing the attaching portion 641 to the anode substrate 60 with fritted glass or the like. The supporting portion 642 and the metallic piece 643 are welded by applying an electric current on a pair of heating electrodes disposed at bottom of the supporting portion 642 and

top of the metallic piece 643. When the filament or the damper is welded by using the resistance heating welding, the welding flames spark and the welding remnants due to the welding flames are attached to other components, deteriorating the display quality. For instance, in the case that the filament 61 or the damper 63 is welded, the welding remnants may have direct contact with the fluorescent substance applied to the anode electrode 65, thereby being stuck thereto, or the welding remnants, which are attached to the anchor 62 or the supporting member 64 in the welding work, may get stripped off in the subsequent processes to be stuck to the fluorescent substance, making the poor display. Further, the welding remnants may develop a short-circuit between the electrodes. On the other hand, when the welding is performed, the portions excepting for the welding points are also heated. This results in the anchor and the supporting member or the like being expanded, developing cracks in the anode substrate.

The complicate shape of the anchor 62 or the support 64 increases processing expenses thereof. Additionally, the supporting members should have a predetermined strength, setting a limit on the miniaturization of the device. For this reason, it is difficult to make the display device thin. Further, the space excepting for the display area, so-called dead space, cannot be saved.

There are shown in Fig. 7(a), 7(b) and 7(c), a partial top view of a prior art display device including wire grids 71

mounted on an anode substrate, and a cross sectional view taken along a line Y1-Y1 of Fig. 7(a), respectively. Fig. 7(c) shows a cross sectional view of a modification of the fixing portion of the wire grid of Fig. 7(b).

As shown, a reference numeral 701 represents an anode substrate made of insulating material, e.g., a glass, a ceramic or the like; 702 a side plate made of, e.g., a glass; 71 wire grids (only one is designated by the reference numeral); 75 anode electrodes (only one is designated by the reference numeral); 761 cathode filaments (only one is designated by the reference numeral); and 762 a support for the cathode filament 761, respectively.

Referring to Fig. 7(b), under the condition of applying a predetermined tension force to the wire grid 71 mounted on the jig (not shown), the wire grid 71 is mounted on the spacer 72 made of an insulating material. Next, one end 712 of the wire grid 71 is interposed between the anode substrate 701 and the side plate 702, and similarly the other end thereof is interposed between the anode substrate 701 and another side plate (not shown). Thereafter, the ends of the wire grid 71, the anode substrate 701 and the side plates are connected to each other by using the fritted glass (not shown).

Referring to Fig. 7(c), under the condition that the predetermined tension force is exerted on the wire grid 71, both ends (one shown) of the wire grid 71 are fixedly attached to the spacer 72 by using the fritted glass (not shown). The wire grid

71 is connected to grid terminals 714 (one shown) via conductive members 713 (one shown).

The fluorescent display device is fabricated by installing the wire grid and then performing the heating process several times. For example, the fritted glass is used for fixedly attaching the wire grid in the prior art of Fig. 7. Therefore, the heating temperature in the steps thereafter should be maintained at a lower level than the melting point of the fritted glass. However, it is cumbersome to maintain the foregoing temperature and sometimes the fritted glass is melted to deviate the initial positions of the members fixed thereby. Moreover, since the components constituting the display device should be made of the materials which can undergo the heating process at a temperature below the melting point of the fritted glass, the applicable materials are limited.

[PROBLEM TO BE SOLVED BY THE INVENTION]

An object of the present invention is, for solving the aforementioned problems due to the conventional resistance heating welding of a filament or a damper and the aforementioned drawbacks due to the fritted glass for the conventional wire grid, to install a linear member, which is installed under the condition that a tension force is applied thereto, such as a wire grid, a filament, a damper or the like, by an ultrasonic welding with ease without damaging other components, thereby reducing the install space.

[SOLUTION PROVIDED BY THE INVENTION]

In accordance with a preferred embodiment of the present invention, there is provided a fluorescent radiation device including: a linear member fixed under the condition that a tension force is applied thereto, wherein a fixing portion or an attaching portion of the linear member includes a body member and a metallic additional member, wherein the additional member is fixed by an ultrasonic bonding to a metal film formed on a base.

In accordance with another preferred embodiment of the present invention, there is provided the fluorescent radiation device, wherein the metal film formed on the base is formed in a thin film.

In accordance with still another preferred embodiment of the present invention, there is provided the first fluorescent radiation device or the second fluorescent radiation device, wherein the linear member is formed in a cladding of a metallic member of the body member and a metallic member of the additional member.

In accordance with still another preferred embodiment of the present invention, there is provided the first fluorescent radiation device or the second fluorescent radiation device, wherein the body member of the linear member is a wire grid having a metallic member and an insulating member.

In accordance with still another preferred embodiment of

the present invention, there is provided the first fluorescent radiation device or the second fluorescent radiation device, wherein the linear member is a cathode filament where the additional member is formed at the fixing portion or the attaching portion.

In accordance with still another preferred embodiment of the present invention, there is provided the first fluorescent radiation device or the second fluorescent radiation device, wherein the linear member is a wire damper where the additional member is formed at least at the fixing portion or the attaching portion.

[DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS]

Fig. 1(a), 1(b) and 1(c) set forth a partial top view of an anode substrate of a display device in accordance with a first preferred embodiment of the present invention and a cross sectional view taken along a line X1-X1 of Fig. 1(a), respectively. Fig 1(c) differs from Fig. 1(b) by the structure of an insulating layer.

As shown, a reference numeral 11 presents an anode substrate made of an insulator, e.g., glass or ceramic as a base; 12 wire grids (only one is designated by the reference numeral) as a linear member, 13 pads (only one is designated by the reference numeral) made of a metallic layer, e.g., Al; 14 spacers (one shown) made of, e.g., glass fiber; 15 anode

electrodes (only one is designated by the reference numeral) having fluorescent substrates thereon.

Referring to Fig. 1(b), the wire grid 12 is formed in cladding of a YEF 426 alloy (Ni 42%, Cr 6%, the remaining Fe) layer 121 and an Al layer 122 formed beneath the YEF 426 alloy layer 121. The YEF 426 alloy layer 121 is a body member of the wire grid. The Al layer 122 is an additional member to be used for the ultrasonic bonding. The wire grid 12 is coupled to the anode substrate 11 by fixedly attaching one end 1221 of the Al layer 122 and one end 1211 of the YEF 426 alloy layer 121 to the Al pad 13.

Although only one side of the wire grid is shown in Fig. 1(b), the other thereof is equally connected to another Al pad.

In the connection of the wire grid 12 and the anode substrate 11, the end 1221 of the Al layer 122 is fixedly attached to the Al film pad 13 by using the ultrasonic bonding. On the other hand, the attachment of the wire grid 12 is performed under the condition of applying the predetermined tension force thereto. In this case, the wire grid 12 maintains its vertical position by the spacers 14.

When the wire grid 12 has pitch of 0.3mm or more, the end 1211 of the YEF 426 alloy layer 121 of the wire grid 12 is interposed between the Al pad 13 having a greater width than the line width of the wire grid 12 and the Al wire (not shown) arranged in the cross direction of the wire grid 12 with length greater than the line width of the wire grid 12. Under this

condition, both ends of the wire grid 12 are secured at the Al pads 13 by using the ultrasonic wire bonding. In this case, the binding strength of the wire grid to the Al pads is improved. This is also suitable to a cathode filament and a wire damper as will be described later.

The wire grid 12 is obtained by cutting a structure, where the YEF 426 alloy layer 121 is stacked on the Al layer 122, into a width of 0.05 mm. This cutting process is performed by a suitable cutter, but may be performed by a chemical method, e.g., etching.

There is shown in Fig. 1(c) in which an Al layer 1222 is provided only under the end 1211 of the YEF 426 alloy layer 121. The YEF 426 alloy layer 121 is the body member. That is, the YEF 426 alloy layer 121 plays a role of the grid. The Al layer 1222 is an additional member used for the ultrasonic bonding.

Referring to Figs. 1(b) and 1(c), the wire grid 12 has a width of 0.05 mm, the YEF 426 alloy layer 121 has a thickness of 0.04 mm, the Al layer 122 (or 1222 in Fig. 1(c)) has a thickness of 0.01 mm, the Al film pad 13 has a thickness of 1.2 μm and the wire grid has a pitch of 0.1 mm.

Further, the ultrasonic bonding is performed under the condition of ultrasonic frequency of 38 kHz, power of 200 W, pressing force of, if the bonding area is 0.25 mm^2, 11N, if 1 mm^2, 21 N, if 4 mm^2, 31 N, bonding time of 0.3 sec., amplitude of 70 V. In any case, the binding strength is equal to or more than 1.5 N of the fracture strength of the wire grid 12. To be more

specific, if the binding area is 0.25 mm^2, the binding strength is equal to or more than 15 N, if 1 mm^2, it is equal to or more than 23 N, if 4 mm^2, it is equal to or more than 35 N. Consequently, the binding strength is ten times or more as the fracture strength of the wire grid 12.

In consideration of the thermal expansion coefficient, the strength, the presence and absence of the production of the undesired gas or the like, the YEF 426 alloy is typically used as the material of the components of the fluorescent display device. But, it is difficult to apply the ultrasonic bonding to the YEF 426 alloy. Generally, Al, Cu, Au, Ag, Pt, V or the like are suitable for the ultrasonic bonding, but Fe or steel plate, particularly alloy made of Ti, Ni, Zr or the like are unsuitable. Since the YEF 426 alloy is made of a group selected from Ni, Fe, Cr, it is unsuitable for the ultrasonic bonding. However, the wire grid 12 in accordance with the embodiment is suitable for the ultrasonic bonding. To be more specific, it is found that, if the wire grid is fabricated by using the Al layer as well as the YEF 426 alloy layer 121, the resulting wire grid is suitable for the ultrasonic bonding.

Since the wire grid in accordance with this embodiment is suitable for the ultrasonic bonding, there will be no evaporation of the Al pad 13 due to the heat. Therefore, the Al pad can be formed of the thin film. In this case, it can be formed in an identical process as the outside extracting wirings of the anode electrode (anode wiring), thereby facilitating the

fabrication of the device.

Since the wire grid 12 is fixedly attached by using the ultrasonic bonding, there will be no damages inflicted on other components owing to the heat. Further, since its attachment does not require the fritted glass, it is easy to attach the wire grid 12 and to control or maintain the temperature in the processes subsequent to the attachment process of the wire grid 12 and it is possible to bring down the amount of the undesired gas of contaminating, e.g., the fluorescent substrate.

In this embodiment, the YEF 426 alloy has been employed for wire grid 12, but a stainless steel or the like can be used.

Fig. 2(a),2(b) and 2(c) depict a partial top view of an anode substrate 11 of a display device in accordance with a second preferred embodiment of the present invention and a cross sectional view taken along a line X2-X2 of Fig. 2(a), respectively. Fig 2(c) differs from Fig. 2(b) by the structure of an insulating layer.

As shown, the second display device includes a wire grid 22 having an insulating layer 222 and a YEF alloy layer 221 on the insulating layer 222. Between the anode substrate 11 and one end of the wire grid 22, an Al layer 231 is formed. The insulating layer 222 is formed by depositing, e.g., ceramic and has a thickness of about 1 to about 2 μm. The YEF 426 alloy 221 and the insulating layer 222 are a body member of the wire grid. The Al layer 231 is used as an additional member for the ultrasonic bonding. The insulating layer 222 is provided on the

anode electrodes 15 (only one is designated by the reference numeral). The wire grid 22 is fixedly connected to the Al pad 13 by using the ultrasonic bonding via the Al layer 231 forming on one end of the wire grid 22.

The YEF 426 alloy layer 221 and the Al layer 231 are electrically connected to each other via the conductive material in the through-hole 2221. Otherwise, this connection may be achieved by using conductive material used for coating the YEF 426 alloy layer 221, the insulating layer 2222, the Al layer 231 and the Al film pad 13.

After cutting one end of the insulating layer, the Al layer 231 may be formed to be in contact with the YEF 426 alloy layer 221.

As shown in Fig. 2(c), the wire grid 22 has the oxidation 2211 (one shown) at bottom of the YEF 426 alloy layer 221 and the Al layer 232 on both ends. The oxidation 2211 is obtained by, firstly forming an oxidation layer to bottom of the YEF 426 alloy layer 221 and then cutting both ends thereof having a predetermined length therebetween. The Al layers 232 (one shown) are formed at a location at which the foregoing oxidation layer is cut. The oxidation 2211 may be formed by using, e.g., anodizing. The oxidation 2211 has a thickness of about 5 to about 10 μm. After cutting work of the oxidation layer, the Al layer 232 is formed on the YEF 426 alloy layer 221. The Al layer 232 is fixedly attached at the Al pad 13 by using the ultrasonic bonding.

On the other hand, without the cutting work of the oxidation layer, the Al layer 232 may be fixedly attached at the oxidation layer. In this case, the YEF 426 alloy layer 221 and the Al layer 232 are electrically connected to each other by using the conductive material.

In this embodiment, the wire grid 22 is directly overlapping with the anode electrode 15, thereby making the fluorescent display panel thin. Further, the vibration of the wire grid is prevented which in turn reduces its pitch, facilitating the device high resolution.

As the body member of the wire grid 22, the stainless steel may be employed.

Fig. 3(a) and 3(b) depict a partial side view of a wire grid 32 of a display device in accordance with a third preferred embodiment of the present invention and a cross sectional view taken along a line X3-X3 of Fig. 3(a), respectively.

As shown, the wire grid 32 has a YEF alloy wire 321 and an Al layer 323 deposited on the periphery of the YEF alloy wire 321 by using a vacuum evaporation. The wire 321 is a body member of the wire grid 32, and the Al layer 323 is an additional element for the ultrasonic bonding. The YEF alloy wire 321 has a diameter of, e.g., about 50 μm and the Al layer 323 has a thickness of, e.g., about 2 μm. The attachment of the wire grid 32 is achieved by using, e.g., the ultrasonic bonding.

Since the wire grid 32 has in its whole periphery the Al layer 323, it is possible to stick the wire grid 32 to the Al

pad free from the binding direction.

As the body member of the wire grid 32, the stainless steel may be employed instead of the YEF 426 alloy.

Fig. 4(a) and 4(b) depict a partial side view of a wire grid 33 of a display device in accordance with a fourth preferred embodiment of the present invention and a cross sectional view taken along a line X4-X4 of Fig. 4(a), respectively.

As shown, the wire grid 33 has a YEF alloy wire 331 and an Al layer 332 deposited on the periphery of an end of the YEF alloy wire 331 by using a vacuum evaporation. The wire 331 is a body member of the wire grid 33, and the Al layer 332 is an additional member for the ultrasonic bonding.

Although the wire grid 33 has only at its end the Al layer 332, it is also possible to stick the wire grid 33 to the Al pad free from the binding direction.

As the body member of the wire grid 33, the stainless steel may be employed instead of the YEF 426 alloy.

Fig. 5(a), 5(b) and 5(c) set forth a partial top view of an anode substrate of a display device in accordance with a fifth preferred embodiment of the present invention and a cross sectional view taken along a line X5-X5 of Fig. 5(a) and a cross sectional view taken along a line X6-X6 of Fig. 5(a), respectively.

As shown, a reference numeral 41 presents cathode filaments (only one is designated by the reference numeral), 411

a tension force applying spring portion(only one is designated by the reference numeral) for exerting a predetermined tension force on the filament 41; 42 damper of the filament; 43, 45 filament Al pads; and 44, 46 filament spacers (one shown) made of, e.g., glass or metal.

The filament 41 has a core wire made of a tungsten or tungsten alloy and carbonate for electron emission deposited on the periphery of the core wire. On the other hand, a filament Al film 413 is formed at one end 412 of the filament 41 with a thickness of about 2 μm to envelope the end 412, is an additional member for the ultrasonic bonding (that is, the Al film 413 has an identical structure as the Al layer 332 as shown in Fig. 4(b)). Furthermore, after eliminating carbonate of the end 412 of the filament 41, the Al film 413 is formed thereon exposed.

The filament 41 is connected to the anode substrate 11 by bonding both ends 412 (only one is designated by the reference numeral) thereof to the anode substrate 11. For instance, one end 412 of the filament 41 is bonded to the anode substrate 11 by ultrasonic-welding the filament Al film 413 to the filament Al pad 43. But without the elimination, the Al film 413 may be formed thereon. But, the binding strength is greater in the former. Similarly, the other end (not shown) of the filament 41 is also bonded to the anode substrate 11. The filament 41 has a predetermined vertical position sustained by using the filament spacers 44 (one shown). The spacers 44 have a circular shape in

a section, but as long as it is possible to tightly maintain the wires.

The filament 41 is thermally expanded owing to the heat generated in driving the fluorescent display device. The spring portion 411 serves to apply a predetermined tension force on the filament 41 in response to the change in the length thereof. The tension force applying spring portion is limited to the coiled shape as long as it is possible to apply the tension force.

Referring to Fig. 5(c), a reference numeral 42 illustrates a damper; 45 a damper Al pad; 421 a damper Al film; 46 a damper spacer. The damper 42 is made of metal line of, e.g., W, Mo, stainless. One end of the damper 42 is provided with a damper Al film 421 as an additional member for the ultrasonic bonding. The damper 42 is installed at the anode substrate 11 by ultrasonic-bonding the damper Al film 421 to the damper Al pad 45. Similarly, the other end (not shown) of the damper 42 is stuck to the anode substrate 11 having anode electrode 15. The connection of the damper 42 to the anode substrate 11 is performed under the condition of applying the predetermined tension force to the damper 42. Further, since the damper 42 is not heated in driving the fluorescent display device, it is not required for members like the spring portion 411 of the filament 41.

The spacer 46 has a circular shape in a section but, as long as it is possible to tightly maintain the wires.

The Al film may cover not only the ends of the damper but also the remaining portion thereof. Further, the Al film may be formed in such a way that only a portion of the ends of the damper is covered therewith.

In this embodiment, only by including the Al film to the body member of the filament or the damper, it is found that the bonding work of the filament or the damper can be achieved by using the ultrasonic bonding.

In foregoing embodiments, the Al films or the Al pads provided on the anode substrate may be formed of the thin film or the thick film (formed by using, e.g., the screen printing). Further, the Al films may be formed on the metallic components. Otherwise, the metallic components may be made of an Al. That is, the metal films may be separately formed on the base or may be formed to be integral with the base.

The additional members for the ultrasonic bonding and the pad or the film therefor formed on the anode substrate may be made of materials beside the Al, e.g., copper, silver, gold, white gold, vanadium or the like. In this case, the additional members and the pad or the film may be made of different materials from each other, but when they are made of an identical material to each other, the bonding strength therebetween is best.

The linear members such as the wire grids, the filaments, or the dampers may be formed on a front substrate opposing the anode substrate. It is also possible that they are partially

formed on the anode substrate and the remaining is formed on the front substrate.

Although the above discussions refer to a situation where the fluorescent display device includes a cathode filament, the present invention can be applied to a field emission fluorescent display device, a fluorescent radiation device such as a fluorescent radiation device for use in a printer head using the principle of the fluorescent display device, a radiation device for a large screen display apparatus, a CRT, a plasma display or the like.

[EFFECT OF THE INVENTION]

In the present invention, an additional member for ultrasonic bonding is formed at a linear member, which is installed under the condition that a tension force is applied thereto, such as a wire grid, a filament, a damper or the like. In this way, the linear member can be ultrasonic-bonded.

Since the linear member can be fixed by the ultrasonic bonding in the present invention, other components are not damaged by a heat. Further, even if a metal layer, which is made of, e.g., aluminum and is formed on an anode substrate, is a thin film, the present invention can fix the linear member without damaging the thin film. Therefore, in the present invention, the fluorescent display tube can be made very thin. Further, since a supporting member of a complicated shape, such as a conventional anchor, is not employed in

fixing a filament or a damper, the fixing process becomes simple, and the fluorescent display tube can be made thin.

Moreover, since the present invention does not introduce a fritted glass in fixing a wire grid, a baking operation (i.e., an operation of melting and solidifying a gas powder) is not required, and further, it is not necessary, in the heating process after fixing the wire grid, to consider a melting or a softening of the solidified fritted glass. Consequently, the operation can be shortened, and the heating process becomes easier.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 sets forth a top view and a cross sectional view of an anode substrate of a display device including wire grids or the like in accordance with a first preferred embodiment of the present invention;

Fig. 2 depicts a top view and a cross sectional view of an anode substrate of a display device including wire grids or the like in accordance with a second preferred embodiment of the present invention;

Fig. 3 illustrates a top view and a cross sectional view of a wire grid in accordance with a third preferred embodiment of the present invention;

Fig. 4 depicts a top view and a cross sectional view of a wire grid in accordance with a forth preferred embodiment of the the

present invention;

Fig. 5 sets forth a top view and a cross sectional view of an anode substrate of a display device including a filament, a damper or the like in accordance with a fifth preferred embodiment of the present invention;

Fig. 6 provides a top view and a cross sectional view of an anode substrate of a conventional display device including a filament, a damper or the like; and

Fig. 7 represents a top view and a cross sectional view of an anode substrate of a conventional display device including wire grids.

Explanation about reference numbers

11: anode substrate

12, 22, 32, 33: wire grids

121, 221: YEF 426 alloy layers

122, 1222, 231, 232, 323, 332, 413, 421: Al layers

13: Al pad

14, 44, 46: spacers

15: anode electrode

321, 331: YEF 426 alloy wire

2211: oxidation

222: insulating layer

2221: through hole

41: filament

411: spring portion

42: damper

43, 45: Al pad

[ABSTRACT]

[PROBLEM TO BE SOLVED]

To fix a linear member, which is fixed by imparting tension of a wire grid, a filament, a damper or the like, by ultrasonic bonding in a fluorescent display tube or the like.

[SOLUTION]

The wire grid 121 includes a YEF 426 alloy layer and an aluminum film 122, and an end 1221 of the aluminum film 122 is fixed to an aluminum film pad 13 of an anode substrate 11 by ultrasonic bonding. The aluminum film 122 can be formed only at an end of the wire grid 12, just like an aluminum film 1222.

[SELECTED DRAWING] Fig. 1